NOTES

ON

INTESTINAL WORMS

BY

J. T. CALVERT, M.B. (LOND.), D.PH., (CAMB.), MAJOR, I.M.S.

COMPILED FOR THE USE OF HOSPITAL ASSISTANTS

IN ACCORDANCE WITH THE INSTRUCTIONS OF COL. T. H. HENDLEY, C.I.E., I.M.S., INSPECTOR-GENERAL, CIVIL HOSPITALS, BENGAL.

CALCUTTA:

PRINTED AT THE BENGAL SECRETARIAT PRESS.

1902.

INTRODUCTORY.

I. A few preliminary remarks may facilitate the subsequent study of the contents of this little pamphlet.

Parasite, meaning literally a hanger-on at the tables of the great, is a term used to designate a plant or animal which lives upon or within another living organism.

Host.—The animal or plant who harbours these parasites, in whose organs they dwell and from whose tissues or fluids their sustenance is derived, is termed the host.

Parasites may be external or internal.

Epizoa, meaning literally "upon an animal," are parasitic animals which live upon or in the structures of the skin of other animals. A good example of these is the Acarus Scabiei.

Entozoa, meaning literally "within an animal," are parasites which live inside the body of another animal.

The latter subdivision comprises several classes, of which two only will be considered here.

Parasitical animals and plants exist everywhere. It is as natural for a man to have worms in his bowels as lice in his hair, and both internal and external parasites are found in man as in all other mammals. Man differs from other animals in that, by constant efforts, thanks to his scanty hairy covering, it is possible for him, whilst living in a state of civilization, to keep his body clean

and free from external parasites. By similar efforts and the use of his intelligence, he should likewise be able to avoid acting as host to the more dangerous and troublesome internal parasites. The word intelligence is used advisedly, for whereas external parasites or the effects they produce can be recognized by the unobservant, a trained intelligence is required to recognize with certainty many of the internal forms. In proof of which it may be noted that whilst the round worms, thread worms, and more common tape-worms have been known and recognized from ancient times, the other parasitic worms have only been discovered within the last forty years. It must not be thought that because they were for so long unrecognized, they were on that account unimportant. On the contrary, the larger intestinal worms, although a cause of sickness, rarely result in death; whereas one of the smaller and more recently discovered intestinal parasites, viz., Ankylostomum duodenale, does directly when in large numbers, and possibly indirectly when in smaller numbers, lead to the death of the host harbouring them.

It might possibly be thought that the presence of a few intestinal worms, giving rise, as they sometimes do, to little inconvenience to their host, was not a matter of importance. As a matter of fact, this is not so. The people who harbour these parasites are the best judges of the trouble and inconvenience they cause, and from the numbers who now flock to the Bengal dispensaries, to seek treatment which experience has taught them is effective and brings relief, it is evident that the presence of these worms is usually attended with considerable discomfort, if nothing worse. The following figures are

instructive, giving as they do the total number of all patients (in and out) attending the Bengal dispensaries during the past three years, and of these the total number who were treated for worms:—

	Treated for worms.	Total treated.
1898 ...	150,637	2,834,112
1899 ...	153,638	2,879,845
1900 ...	174,172	3,291,243

These figures relate to the larger and more easily recognized parasites. Now that, through the foresight of Colonel T. H. Hendley, C.I.E., I.M.S., the majority of dispensaries have been provided with plantation microscopes, thus enabling the medical officer to diagnose with facility and certainty the presence of the smaller worms by the detection of their ova, it is to be expected that the number of patients treated for worms will increase yearly. An increase will certainly take place if medical subordinates conscientiously use the improved means of diagnosis now placed at their disposal.

II. A few explanatory remarks on the two orders of intestinal worms which will subsequently occupy our attention may not be out of place.

(1) *Cestoidea*, from the Greek word *cestus*, a band, are so called on account of their ribbon or band-like shape.

The cestodes or tape-worms are all endoparasitic, and, with one exception, attain maturity solely within the alimentary canal of vertebrates. The head (scolex) is attached to the mucous membrane of the host by means of suckers or hooks, but there is no mouth, nor any trace of an alimentary canal, at any stage of their life history.

For nourishment they absorb, through the skin, the previously digested food (of the host) which surrounds them. The life histories of tape-worms are very peculiar, and consist of two well-marked stages. These two stages are passed in two absolutely distinct animals or hosts. The animal or host in which sexual maturity is attained is termed the *Final Host.* The animal or host in which the larvæ first develop is called the *Intermediate Host.* It is necessary for the development and continuation of the life of the parasites that the intermediate host should be eaten by the final host. Tape-worms exist amongst all groups of vertebrates and are not peculiar to man.

(2) *Nematoidea*, from two Greek words meaning likeness to a thread, are so called from the thread-like appearance of their cylindrical, elongated bodies.

The nematodes, or thread worms, consist of a great number of species, living under most varied conditions. They abound in moist soil, around the roots of plants. They are found living parasitically in plants, causing the formation of galls and other pathological growths, and they are found living as parasites in the alimentary canal of man and various domesticated animals. No less than 22 species have been described as parasitic in man, and amongst them are some of the most dangerous parasites that the human organism is liable to, including as they do the Ankylostomum duodenalis, Trichina spiralis (the cause of very fatal epidemics of Trichinosis amongst consumers of infected pork), Filaria medinensis (the Guinea worm), and Filaria sanguinis hominis (the cause of the various forms of elephantiasis).

The nematodes are peculiar in that, although parasitic, their parasitism has resulted in but little structural degeneration. With one or two exceptions, they are bisexual and possess an alimentary canal, nervous, muscular, and excretory systems.

Explanation of terms used.

Acarus Scabiei.—A small external parasite, the irritation of whose presence leads to the symptoms of scabies or itch.

Anthelmintics.—Remedies against worms.

Auto-infection.—Self-infection.

Bisexual.—Having the reproductive organs of both sexes.

Cyst.—A bladder or sac.

Cysto-cercus.—Larvæ or bladder worms of tape-worms.

Cloaca.—A common outlet to the rectum and bladder.

Operculum.—A lid or cover: eggs having the appearance of a lid or cover at one extremity are said to be operculated.

Ova.—Plural of ovum, an egg.

Proglottides.—The separate joints, portions, or segments of a tape-worm containing the generative organs or ova.

Rhabditiform.—Resembling a rhabditis. A species of parasitic round worms.

Scolex.—Knot-like head of a tape-worm, from which the segments arise by budding.

INTESTINAL WORMS.

Of the worms which occur as parasites in the body of man, we shall here deal only with two orders, viz.—(I) *Cestoidea*, or tape-worms; (II) *Nematoidea*, or round worms.

I. Tape-worms	...	Tænia solium. Tænia mediocanellata. Bothriocephalus latus.
II. Round worms	...	Ascaris lumbricoïdes (common round worm). Oxyuris vermicularis (common thread worm). Trichocephalus dispar (whip-worm). Anchylostomum duodenale.

Tæniadæ—General.—The tape-worms noted above have two phases of existence. Supposing an adult worm in the human intestine, the eggs of the worm, either free or contained in the mature segments, are passed with the fæces. If in the latter, they subsequently escape from the segment, owing to its rupture or decomposition, and are thus scattered on the ground, leaves, grass, or elsewhere, wherever the fæces happen to have been deposited. Many of the eggs here perish. Some of them, however, are swallowed on grass, or in water, and find their way into the intestines of some appropriate animal.

Intermediate Host Stage.—This is, in the case of the Tænia solium, the pig; of the Tænia mediocanellata, the cow; and of the Bothriocephalus latus, the pike or eel. On its arrival in the stomach, the shell of the ovum is dissolved by the gastric juice, and the embryo thus set free. The embryo bores its way into some small intestinal vessel, and is carried along by the blood stream. Arrived at some suitable spot, such as the muscles, it remains and develops. Ultimately it presents a head, resembling that of the perfect worm, a neck, and a little globular bladder like appendage

(cyst) filled with clear fluid. In this stage it is called a cysticercus. It has no sexual organs, and cannot undergo further development until its arrival in the human intestine. The stage in the *Intermediate Host* is now finished. Should the meat of the animal constituting the intermediate host not be eaten, the cysticercus perishes. When, however, the flesh is consumed, the cysticercus, arrived in the alimentary canal, attaches itself by its head to the mucous membrane, the globular appendage is dissolved, and from the hinder end of the neck a series of segments arise, which successively grow until the adult worm is formed.

Tænia Solium.—This is the common tape-worm. It was so called because it was thought to exist as a solitary parasite in the bowels. This is now known to be incorrect, as two, three, or even more worms may occur together. It is a flat, elongated, ribbon-shaped worm, usually from 10 to 12 feet long, and resides in the small intestine. Its head (scolex) is about the size of a pin's head; is provided with a circle of 24 hooklets and 4 laterally placed suckers. Behind the head are a number of very small, thin segments, constituting the neck. The segments gradually get broader and larger towards the other extremity. As they become larger, the segments acquire sexual organs, and are then called proglottides. Each segment contains male and female organs. A fully-developed Tænia solium may contain 850 segments, of which the last 80 or 100 would be mature. The segments of the neck are broader than they are long: subsequently, as they develop, the segments become longer than they are broad. A mature proglottis measures half inch long by one-fourth inch broad. If one of the mature segments be washed in clean water, pressed firmly between two microscope slides, and held up to the light, the uterus, which is an elongated cavity running the whole length of the segment and giving off branches on each side, will be seen. The eggs are almost globular in shape, and measure about $\frac{1}{700}$th inch in diameter. They have a thick brownish shell, both

concentrically and radially striated. The egg when ripe contains a 6-hooked embryo. The worm attains its full growth in from three to three and a half months. Its cysticercus gives the well-known spotty white appearance to "measly pork."

Tænia Mediocanellata vel Saginata.—The beef tape-worm very closely resembles the Tænia solium just described. It differs in that its head is three times as large, is provided with four suckers, but has no hooklets. The adult worm contains about 11 to 1,300 segments and attains a length of 12 feet. The eggs are oval, $\frac{1}{700} \times \frac{1}{850}$ inch in measurement, and otherwise closely resemble those of the Tænia solium. The cysticercus of this worm is found in beef and veal.

Bothriocephalus Latus.—This tape-worm is mentioned here because, although it has not as yet been discovered in a native who has never left the country, it has recently been found in Japan, and by drawing attention to its existence the fact of its presence in this country may subsequently be demonstrated. This worm exceeds in size either of the preceding, since it may attain a length of 20 to 26 feet with some 3,000 segments. The head is elongated and has two long suckers. The eggs measure $\frac{1}{370}$ inch $\times$ $\frac{1}{570}$ inch, are oval in form, with a rather thin brownish shell, which opens by a lid at one end (operculated).

From the eggs ciliated embryos provided with six hooklets are developed. These embryos are swallowed by fish (pikes and eels), and in the muscles of these fish the cysticerci are found.

Symptoms of Tape-worms generally.—The effects of the presence of a tape-worm are vague and uncertain. In many cases symptoms are absent. The patient often begins to complain for the first time after he is aware that he is passing segments of the worm, although the parasites must then have been present some months. The symptoms usually complained of are —irregular appetite, salivation, uncomfortable sensations in the bowels, pain and colic: morbid sensations at

distant parts may be produced—itching at the nose or anus, headache, giddiness, mental depression, chorea, hysterical, epileptic, or even maniacal fits.

Diagnosis.—The presence of the segments is conclusive: sometimes the eggs may be found in the stools.

Prevention.—All meat intended for human consumption should be properly inspected. The meat should be thoroughly cooked. The stools of all patients affected with tape-worm, and particularly any segments which may be passed, should be burnt.

Treatment.—Having ascertained the presence of a tape-worm by the appearance of the segments in the fæces, our object is first to kill it and subsequently to cause its removal by a purgative. To kill the worm it is necessary that the drug administered should come into immediate contact with the parasite. This object is obtained by administering the medicine in the morning after giving a saline purgative the previous evening. A better chance of success is ensured if the patient has in addition been kept on moderately low diet for a day or two previously. Several anthelmintics (remedies against worms) are in use—

Liquid extract of Male Fern.	Dose	45 to 90 ♏.	
Kousso	„	4 „	6 oz. of the infusion.
Pomegranate	„	½ „	2 fl. oz. of the decoction.
Tannate of Pelletierine ...	„	8 „	12 grs.
Turpentine	„	2 „	8 drachms.
Thymol	„	10 „	30 grs.

Pumpkin seeds (1 oz.), for children, powdered up with sugar and honey into a paste.

The most common and most efficacious are the liquid extract of male fern and oil of turpentine. The preparation of male fern must be *fresh.* In the case of either medicine being used, a full dose of castor oil must be administered three hours afterwards. In all cases after expulsion of the worms, search for the head must be made. If this be not expelled, growth will again take place, with the reappearance of segments in the stools after an interval of three months.

Formulæ—

℞

Extract. filicis liquid ...	...	ʒi
Mucilag. tragacanth ...	...	ʒi
Aq. menthaæpip ...	...	ʒi

To be taken as a draught in the morning.

Or

℞

Extract filicis liquid ...	...	ʒi
Sy. zingiber ...	...	ʒi
Tinct. quillaiæ ...	...	30 ♏
Aq. distillat ...	...	ʒi½

To be taken as a draught.

℞

Ol. terebinth ...	...	ʒiv
Ol. ricini ...	...	ʒi

To be taken as a draught.

℞

Thymol ...	...	10 to 30 grs.

Reduced to a fine powder. One such dose every hour to *three* doses, followed by a dose of Pulv. jalapæ co.

For children *over* two years. (Male fern must *not* be given to those under that age.)

℞

Extract filicis liquid ...	...	30♏
Sy. zingiber ...	...	ʒi
Aq. cinnamon ...	...	ʒi
Mucilag. acaciæ ad ...	...	ʒiv

To be given as a draught.

℞

Extract filicis liquid ...	...	20 ♏
Sy. zingiber ...	...	30 ♏
Tinct. quillaiæ ...	...	10 ♏
Aq. cinnamon ad ...	...	ʒii

To be given as a draught.

℞

Thymol ...	...	4 to 8 grs.

To three doses, depending on age and health of child. Precautions as for adults. Not to be given to children under two years of age.

No alcohol, ether, glycerine, turpentine, chloroform, or oils which are solvent of Thymol must be administered until sufficient time has elapsed for the Thymol to have been expelled. Great caution must be exercised regarding its administration in debilitated subjects.

Nematoidea—Round worms.—The worms belonging to this group are elongated, cylindrical, with a true intestinal canal, and provided with a mouth and anus. The male and female are separate.

Ascaris Lumbricoïdes.—This is the common round worm, and in appearance resembles the common earth-worm. The male is seldom seen. The female is from 7 to 12 inches in length, and cylindrical in form, being pointed at both ends. In colour it is slightly reddish or yellowish-brown. It has been estimated that one female can contain sixty millions of eggs. The eggs measure $\frac{1}{340}$th of an inch long by $\frac{1}{410}$th inch broad; they are of a brownish-red colour, with a thick, irregular, nodulated covering, and are found in the stools of those infested with the worm. This characteristic irregular, nodulated appearance is lost as the embryo develops in the eggs, and the shell of the latter then presents a smooth appearance. No intermediate host is required for the early stage of its development, as in the case of the tape-worm: hence its life history is said to be *direct.* It has been shown that if eggs containing embryos are swallowed, the embryos are set free in the stomach or upper portion of the intestinal canal, and thus infect the individual. Recently in China free embryos and eggs containing embryos have been found on certain vegetables, leeks, and onions, which had been manured with human fæces. These worms normally inhabit the small intestine. They have, however, frequently been met with elsewhere. Thus they may pass into the stomach, whence they have been vomited; they may crawl up the œsophagus and enter the pharynx, the nasal passages, and the Eustachian tube. They may pass into the larynx and produce fatal asphyxia, or into the trachea and lead to gangrene of the lung.

They have been found blocking the bile duct, and in rare instances, when in large numbers, have produced intestinal obstruction. They have been discovered in abscesses in various parts of the abdomen, in the peritoneal cavity, and it is said that even the healthy bowel has been penetrated by these worms. Cases have recently been reported in which patients presenting the symptoms of appendicitis have been relieved after the discharge from the anus of one or more of these worms.

Symptoms.—The symptoms produced by these worms vary according to the number of them which are present and the irritability of their host. From the fact that in some parts of Bengal they are present in varying numbers, in about 40 per cent. of adults and 75 per cent. of children, it is evident that they do not ordinarily give rise to much discomfort.

The symptoms usually ascribed to the presence of these worms are—irregularity of appetite, foulness of breath, dyspepsia, excess of saliva in mouth, nausea, vomiting, griping pains in the belly, presence of mucous and blood in the stools.

Reflex symptoms.—Dilatation of the pupils, squinting, irritation of the nostrils and of the anus, grinding of the teeth, vertigo, hysteria, night terrors, and convulsive seizures. In children a protuberant and tumid belly is a frequent sign.

Diagnosis.—Failing the discharge of the worms, so numerous are the eggs passed by the female ascaris that a microscopical examination of the smallest portion of fæcal matter will at once settle the diagnosis.

Prevention.—To prevent the ascaris from entering the body it is necessary that only pure water should be drunk. Failing this, whenever possible only water which has been boiled should be consumed. It is better to use only vegetables which have been thoroughly cooked. If raw vegetables are eaten, they should be first thoroughly washed in water which has been boiled.

Treatment.—The most efficacious drug to effect the expulsion of the Ascaris Lumbricoïdes is santonine. It is used twice daily in doses of from 1 to 3 grains for children, and from 3 to 6 grains for adults. It is best given combined with a purgative. If preferred, the purgative may be given alone after the second dose. The patient or his attendant should be warned of the curious temporary disturbance of vision which sometimes follows the administration of santonine, objects appearing of a yellow, green, or blue colour. Also note that the urine may assume a greenish-yellow, red, or purple tint.

Formulæ—

[Children two years old and upwards.]

℞

Pulv. santonin	...	...	1 gr.
„ calomel	...	...	½ „

[Children four years old and upwards.]

℞

Pulv. santonin	...	...	2 grs.
„ scammon. co.		...	2 „
„ calomel	...	...	½ gr.

Oxyuris Vermicularis—The Thread worm—Is a very common parasite. It chiefly affects children and young adults. In this country it is frequently met with in older people: thus in the Darbhanga Jail the eggs of this parasite were found in the stools of 9 per cent. of the prisoners. Seen with the naked eye, the adult worms look like short pieces of fine white thread. The female is about half an inch long, the male only one-sixth of an inch in length. The eggs, of which enormous numbers are developed in the uterus of the female, measure $\frac{1}{490}$th of an inch long by $\frac{1}{1100}$th of an inch broad.

In shape they are oval, but unsymmetrical, one side being flatter than the other. The shell is thin, and has a double outline; the eggs generally contain a well-developed embryo.

Life History.—No intermediate host is required for the development of these worms. Every worm present in the intestine represents an egg which has been swallowed by the mouth. The eggs after leaving the parent worm become mixed up with the fæces, and the development of the embryo proceeds up to a certain point. Under favourable conditions the embryo may remain alive, but a prisoner in its shell, for some weeks. Once taken into the stomach, the embryos escape and reach sexual maturity in the upper intestinal tract. Impregnation effected, the female descends to the cæcum, and there remains until her eggs are matured, when she takes up her abode in the rectum. Here part of her eggs are expelled, the female worm passing out along with them in the fæces. Other worms wriggle through the anus at night and may find their way into the vulva, vagina, prepuce, or urethra. The irritation produced by these wandering worms leads to much scratching of the parts and consequent breaking up of the worms: thus their eggs are scattered, smeared over the fingers, and forced under the nails. Inadvertently carried to the mouth, by such habits as nail-biting, thumb-sucking, etc., of children, they are swallowed and thus start fresh generations. By this auto-infection the number of worms present may increase to such an extent that they amount to thousands, and are found fastened together by mucus into masses and balls.

Symptoms.—The chief symptom is troublesome irritation and itching coming on at night. This may become almost intolerable when the worms migrate into the vulva or urethra. The internal irritation produced may lead to the passing of mucoid and bloody stools, to incontinence of urine, morbid sexual excitement, and seminal emission. From the scratching local eczematous conditions arise; whilst reflex disturbances, such as hysteria, convulsions, and chorea, may occur.

Diagnosis.—The diagnosis is readily and easily made by the discovery of the eggs in the fæces on microscopic examination.

Prevention.—In the first instance the parasite is introduced from without by the swallowing of the eggs probably in water, in dust, dirt, direct contaminations from dirty linen, or on raw vegetables. Once introduced it continues and multiplies, as we have shown, by auto-infection. Hence children harbouring this parasite and their surroundings should be kept scrupulously clean, and should not be allowed to sleep with other children, nor to use the same utensils, etc.

Treatment.—The treatment must be directed to expelling the worms present and preventing the re-introduction of their eggs. A purge should be given with a view of driving the worms towards the rectum and clearing out the bowels. After the bowels have acted freely, an anthelmintic enema should be given every other night for at least a fortnight.

To prevent reinfection the buttocks and neighbourhood should be washed with soap and water after each motion. At night the anus should be smeared with some mild mercurial ointment. On recovery some preparation of iron should be administered as a tonic.

Formulæ—

Purgative.

[For a child one year old.]

℞

Pulv. jalapæ comp.	...	... 2 grs.
„ hydrarg. cum creta		... 1 gr.

[For a child 3 to 6 years old.]

℞

Hydrarg. subchlor.	...	... 1 to 2 grs.
Pulv. scammon. comp.	...	... 2 grs.

[For a child aged 6 years.]

℞

Hydrarg. subchlor.	...	... 1 gr.
Jalapæ resin	...	... 2 grs.
Pulv. scammon.	...	... 5 „

Enemata.

These should not exceed—

4 to 6 oz. for a child.
One pint for an adult.

The following may be used :—

(1) Infusion of quassia	...	B.P.
(2) Salt and water ...	...	3ii to a pint.
(3) Lime water.		
(4) Alum solution ...	...	3i to a pint.

Ointment.

(1) Ung. hydrarg.		
(2) ℞ Ung. hydrarg. ...	...	Equal parts.
Glycerini acid carbolici	...	
(3) ℞ Ung. hydrarg. oxidi rub.	...	3i
Vaseline ...	...	3ii

[For adults.]

(4) ℞ Cocain hydrochlor.	...	3 grs.
Bismuth subnit. ...	...	6 „
Lanolin ad ...	...	3i

Trichocephalus hominis—Trichocephalus Dispar—The Whip-worm.—It is so called from its supposed resemblance to a whip. It is especially characterised by having a comparatively thick cylindrical body, terminating anteriorly in a delicate filiform process, which forms about two-thirds of the entire length of the worm.

The male measures from $1\frac{1}{4}$ to $1\frac{3}{4}$ inches long. The female from $1\frac{1}{4}$ to 2 inches in length. The eggs are about $\frac{1}{490} \times \frac{1}{1100}$ inch in size, elongated, oval in shape, deep red brown in colour, have a hard thick shell, and at each end are two clear pale bodies, like small knobs. By means of these they are readily distinguished from the eggs of all other intestinal parasites.

This worm appears to be found everywhere. It was found in 12 per cent. of the prisoners at Darbhanga;

it is said to affect from 2 to 17 per cent. of the population of Russia.

The usual situation for these worms is in the cæcum, where they bury the long anterior filiform neck in the superficial part of the mucous membrane. Occasionally they have been found in the ascending colon—appendix vermiformis,—ileum—and even in the stomach. Usually not more than 20 to 50 are found in one person, though cases are known in which they were present in hundreds and even thousands.

No intermediate host is required to complete their life history: infection is direct. Some of the eggs passed in the fæces finally reach water, where the eggs remain and the embryo is developed, but continue confined in the shell. These embryos swallowed in water are liberated in the stomach by the dissolution of the shell. Subsequently arriving at sexual maturity, which occupies about four weeks, they take up their residence in the cæcum.

Symptoms.—At various times different authors have described diverse symptoms, chiefly of the nervous system, as being due to the presence of these parasites, and it is possible that when present in enormous numbers, various localised neuroses may arise, *e.g.*, headache, grinding of the teeth at night, pruritus, vertigo, nausea, and epigastric pain. One symptom, extensive areas of cutaneous anæsthesia, if combined with some of the above, is said to be characteristic of the presence of this worm.

Diagnosis.—The parent worm is but very rarely found in the evacuations. The diagnosis rests therefore on the discovery of the characteristic eggs on microscopic examination of a small particle of fæces.

Prevention.—Since the embryos are swallowed in water, the only means of prevention consist in providing a pure water-supply, or in boiling drinking-water of doubtful origin.

Treatment.—Thymol, santonine, male fern, and other anthelmintics will cause the expulsion of this worm,

but only partially so, as experience shows that many are left behind untouched. The great point to aim at is, by attention to the drinking-water, to prevent reinfection. If this can be effected, a cure may be hoped for, as the life of the parent worm, and hence its residence in the alimentary canal, would appear to be but short.

Haussman, writing recently, recommends thymol in doses up to 30 grs. daily as the most useful anthelmintic in this disease.

Anchylostomum Duodenale—Dochmius duodenalis—Tunnel worm—Is an extremely common parasite in all tropical and sub-tropical countries. It inhabits the small intestine, chiefly the jejunum, less so the duodenum, rarely the ileum, where it may be found lying between the valvulæ conniventes with its mouth firmly fixed in the mucous membrane by means of its two pairs of teeth.

In appearance it is a small round worm, with its head bent nearly at right angles to the rest of the body. The female, which is the larger, measures $\frac{7}{10}$th of an inch in length: the male only about half an inch. When dead, they are grey in colour—unless full of blood, when they have a reddish-brown appearance.

The males, which are much less numerous than the females (1 to 3), may be distinguished from them by the presence of two long and delicate spiculæ projecting from the cloaca. These parasites differ from those previously described in that they live on the blood, which they suck from their point of attachment on the mucous membrane, whereas the worms previously described obtained their nourishment from the intestinal juices. The number of these worms present in the human intestine at one time may vary from fifty or a hundred to many thousands.

Life History.—The female ankylostoma produces a prodigious and never-ending stream of eggs, which pass out with the fæces. The eggs are oval, $\frac{1}{540} \times \frac{1}{1000}$ inch in measurement, with a delicate, smooth and

transparent shell, through which the greyish yelk can be easily seen. In fresh fæces the eggs are usually 2 to 4 segmented, but unsegmented eggs may be met with. The yelk is of a greyish colour, and is separated from the shell by a comparatively wide zone of perfectly clear transparent fluid. As this fluid and the eggshell are alike quite white, it is by this character alone perfectly distinguished from the eggs of Ascaris lumbricoïdes, which are yellow, and from those of Trichocephalus dispar, which are deep red-brown. From the eggs of the Oxyuris vermicularis it can be distinguished by the facts that the latter is smaller, being only $\frac{1}{490}$th inch in length, has an unsymmetrical outline, being flattened on one side, and contains a manifest embryo.

The eggs thus passed with the fæces (presence of fæcal matter seems to be necessary for their growth) under favourable circumstances develop so rapidly that in one or two days a rhabditiform embryo is born. This minute organism is very active, voraciously devouring what organic matter it can find, and growing rapidly. During this growth frequent changes of skin take place until the worms develop into adult male and female organisms, and are capable of propagation in the free state. This is the so-called *Rhabditic* stage. The meaning of this is that certain parasitic nematodes present the phenomenon of "alternation of generations," the eggs laid by worms in the parasitic stage developing (not into animals like themselves, but) into a form which no naturalist would place even in the same genus. The worms in this stage are free, are in no sense parasitic, but when they reach sexual maturity they give birth to a generation which again takes up a parasitic mode of life, or at any rate is capable of doing so.

The embryos hatched from the eggs of the rhabdites find their way into the human alimentary canal in the mud or dirt adhering to the hands or dishes, mixed with the food or as dust, perhaps occasionally from eating earth.

Symptoms.—When present in large numbers these parasites, by the constant drain of blood and dyspeptic troubles to which they give rise, bring about a grave cachexia, known as *ankylostomiasis*, which not infrequently terminates fatally. In the progress of a fatal case three stages may be noted :—

(1) Dyspeptic. | (2) Anæmic.
(3) Dropsical.

(1) The dyspeptic symptoms are present throughout the other two stages and continue till death. They consist of pain or uneasiness in the abdomen, irregularity of appetite—occasionally defective, often ravenous, perverted appetite, eating of earth, etc., colicky pains, borborygmi, diarrhœa or constipation, fever of irregular type.

(2) These symptoms are followed by those of the second or anæmic stage. The face becomes pale, the mucous surfaces pallid (especially the conjunctivæ), breathlessness, lassitude, palpitations, hæmic bruits, noises in the ear, dimness of vision, and dizziness.

(3) Thirdly the last stage supervenes, in which the face becomes puffy, the feet and ankles swollen, and finally death takes place from syncope or effusions into the serous cavities.

Diagnosis.—The eggs are readily detected by microscopic examination of the fæces, but it by no means follows that on this account a case of anæmia is due to ankylostomiasis, since the eggs have been found in the stools of 83 per cent. of the population in some parts of Bengal. Due regard must be paid to the number of eggs present in the specimen examined, and further other well-known causes of anæmia, malarial fever, Bright's disease, cancer, tubercular disease, pernicious anæmia, leucocythæmia, syphilis, etc., must be excluded by careful examination.

Pathological Anatomy.—The organs are anæmic with fatty degeneration of the heart, liver, and kidneys; general œdema and effusions into serous cavities may be

present. If the *post-mortem* be made shortly after death, ankylostomes will be found attached by their mouths to the mucous surface of the jejunum; if made later, the parasites will be found lying in the mucous coating the inner surface of the bowel. In the neighbourhood of these parasites a number of punctiform ecchymoses in the mucous membrane may be seen.

Prevention—Is a question of conservancy. With 83 per cent. of the population harbouring these parasites and daily passing their eggs in any spot they may choose, but almost invariably in close proximity to dwelling-houses, every other precaution sinks into insignificance compared to this. The first step would be to have certain areas near the village set apart for purposes of defœcation. This would at least limit the infection of the soil to certain definite localities and prevent the wholesale fouling of the village site. Subsequently efforts should be made to introduce pit latrines or trenches. The former is bad, but it is a lesser evil than the universal prevalence of the parasite.

It seems a pity that whilst so much is now being done for the education of the raiyat, a few hints could not be given to him regarding the parasites which prey on him and how to avoid these; for until he does know little progress in the direction we are indicating can be hoped for.

Treatment—Which formerly consisted in the administration of male fern has now almost entirely resolved itself into the use of thymol. The thymol must be finely powdered before it is given. The usual doses are 10 to 30 grs. for adults and 2 to 8 grs. for children, thrice repeated, and followed by a purgative. For formulæ, see page 5. Note also precautions as to use.

Microscopical examination of the fæces.

This is a very simple matter, and, if conducted in accordance with the following directions, is only slightly

disagreeable. When searching for the eggs of intestinal parasites, at least three preparations should be made. A number of small slips of bamboo should be made, about 6 inches long and varying in thickness from a matchstick to a quill. Dip one of these sticks into a little clean water and place a drop on the centre of each of the three slides. Then dip this stick into the fæces to be examined, subsequently rub the soiled end in the water on the slide until this is coloured with the fæcal matter, and drop on a cover slip. After making the preparation the little bamboo stick must be thrown away. If the stools are hard, a little water may be poured over them. A prod with one of the larger slips will thus make a small hole into which a little water may be poured. One of the smaller sticks dipped into this little depression will return covered with a sufficient amount of fæcal matter for examination. The fæces will rarely be found too fluid for examination. If excessively fluid, they may be allowed to stand in a small earthen gallipot. The eggs and more solid contents will sink down to the bottom. After a few minutes the more fluid portion may be poured off. A small bamboo slip may be dipped into the residue and transferred to the slide. It is better to have the preparation too thin than too thick.

The microscope having been placed on a small table near a good light and the little mirror adjusted, the slide is placed on the stage and by rotating the tube slowly the objects under view are brought into focus. A careful search for the eggs is now to be made. Their discovery will be facilitated by always searching in a methodical manner, and thus making sure that no part of the field has been neglected. Thus it is a good plan to first bring the entire periphery under inspection, after which the preparations may be passed under view from top to bottom or from side to side, shifting the slide a little each time. By doing this the investigator can satisfy himself that no part of the preparation has been left unseen.

An egg having been discovered, the following points are to be noted :—

(*a*)
- Size.
- Shape.
- Colour.
- Thickness of shell; also whether it is *smooth*, *rough*, or striated.

(*b*)
- Contents of the egg.
- Presence of yelk sphere (Ankylostoma).
- „ of an embryo (Oxyuris).
- „ of six embryonic hooklets (Tænia solium and Mediocanellata).

(*c*)
- Presence of a lid or operculum (Bothriocephalus distoma).

We will again, for ready reference, with the accompanying diagrams, describe the eggs to be searched for:—

Tænia Solium.—The eggs are nearly globular in shape, about $\frac{1}{700}$th inch in diameter, with a thick brownish shell, both concentrically and radially striated. When ripe, they contain a 6-hooked embryo.

Tænia Mediocanellata.—The eggs are oval, about $\frac{1}{700} \times \frac{1}{850}$ inch in size, and are thus a little larger than those of Tænia solium, which they closely resemble.

Bothriocephalus Latus.—The eggs are oval in shape, $\frac{1}{370} \times \frac{1}{570}$ in size; the shell is thin, brownish in colour, and opens by a lid at one end (operculated).

Ascaris Lumbricoides.—Eggs are barrel-shaped or oval in form, $\frac{1}{340} \times \frac{1}{440}$ inch in measurement, brownish-red in colour, with a thick, irregular, nodulated shell.

Oxyuris.—The eggs are oval, but unsymmetrical in shape, with one side flatter than the other, $\frac{1}{490} \times \frac{1}{1100}$ inch in size; shell thin with double outline; contents usually a well-developed embryo.

Trichocephalus Dispar.—Eggs are about $\frac{1}{490} \times \frac{1}{1100}$ inch in measurement, elongated, oval in shape, have a hard, thick shell, and at each end are two clear, pale

bodies, like small knobs, by means of which they can be easily distinguished from the eggs of all other intestinal parasites.

Ankylostoma.—The eggs are oval, $\frac{1}{540} \times \frac{1}{1000}$ inch in size, with a delicate, smooth, transparent shell; shell and fluid white and transparent; contents 2 to 4, sometimes more, segmented yelk of a greyish colour. This egg is easily distinguished by the white shell and the zone of clear, white, transparent fluid which separates the grey yelk from the shell.

In connection with the plantation microscope with which dispensaries are now being provided, attention may be drawn to the excellent slip of printed instructions, with diagrams, which accompanies the microscope. The instructions and information there given will be found of the greatest use. In working with this microscope the slides and cover slips, which will be found in the case, should, whenever possible, be used.

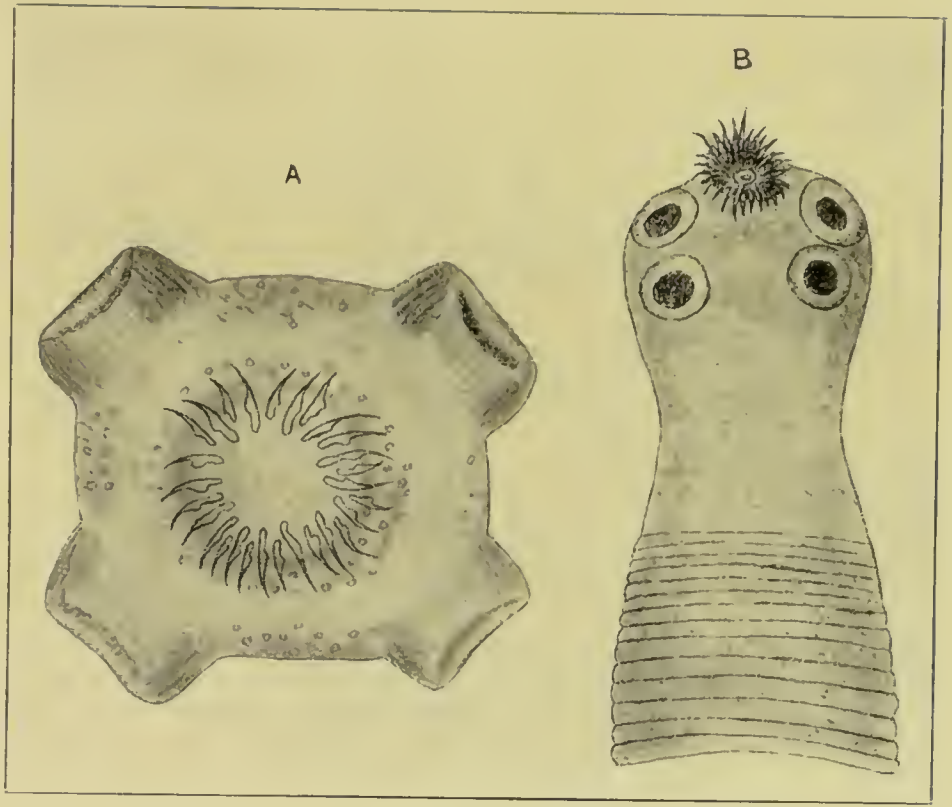
Should it be desired to fix the slides in any position, a couple of rubber bands may be slipped over the ends of the slide and round the staging.

Search for adult worms.

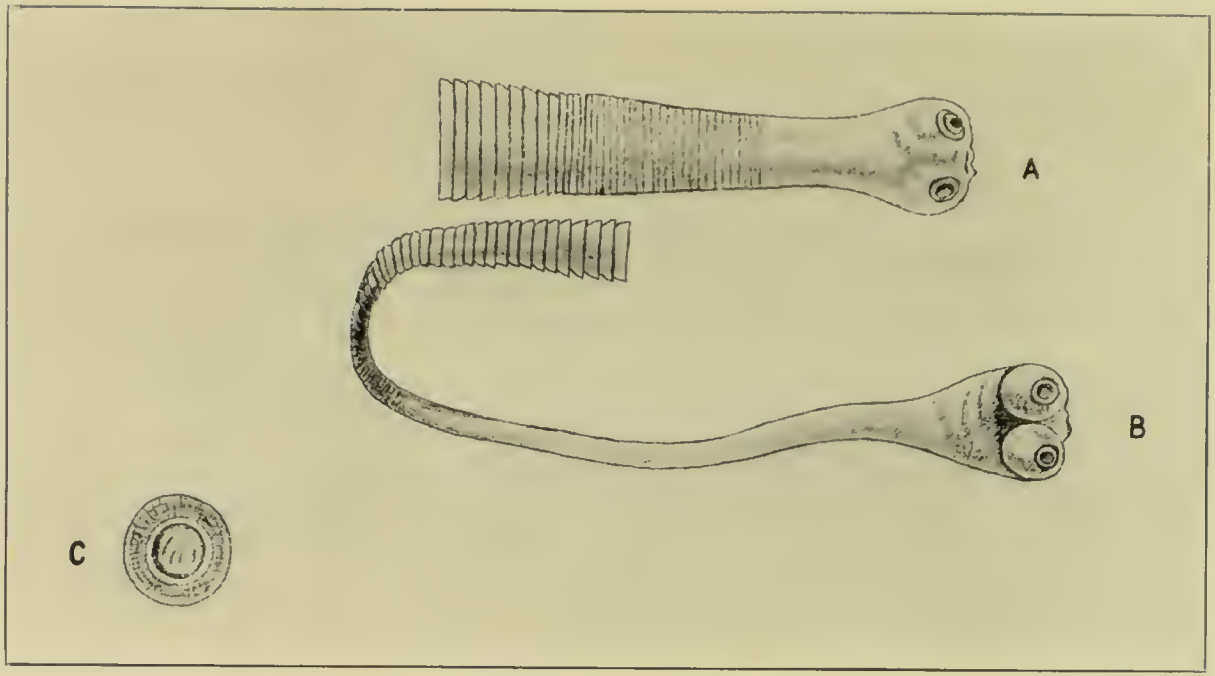
In order to detect ankylostoma and other small worms in the stools, it is necessary that the latter should be broken up and washed. This simple operation can be performed by the hospital *mehter* as follows:— An earthen *gumlah*, a piece of ordinary bazar mulmul cloth, and a few sticks, with rounded ends to prevent the cloth being torn, are all that are required.

The cloth is laid over the mouth of the *gumlah*, and on this the stools are placed. Water is then gradually poured over the fæces, which are meanwhile stirred carefully with one of the sticks. The fæces under this treatment rapidly break up and pass through the cloth, whilst the worms remain on the cloth and can be picked up on a small bamboo stick and placed in a small bottle of rectified spirit for future examination. If the amount of fæcal matter to be dealt with is large, it should be passed through the cloth in small portions at a time.

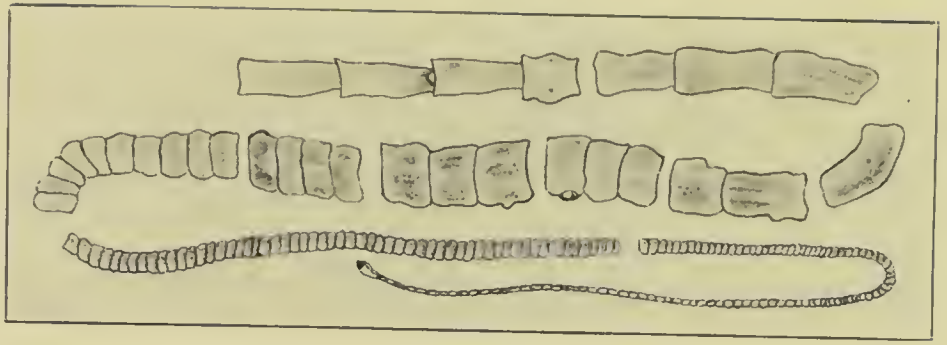
B. S. Press—506J—1,000—13-11-1902—W. M. D'C.



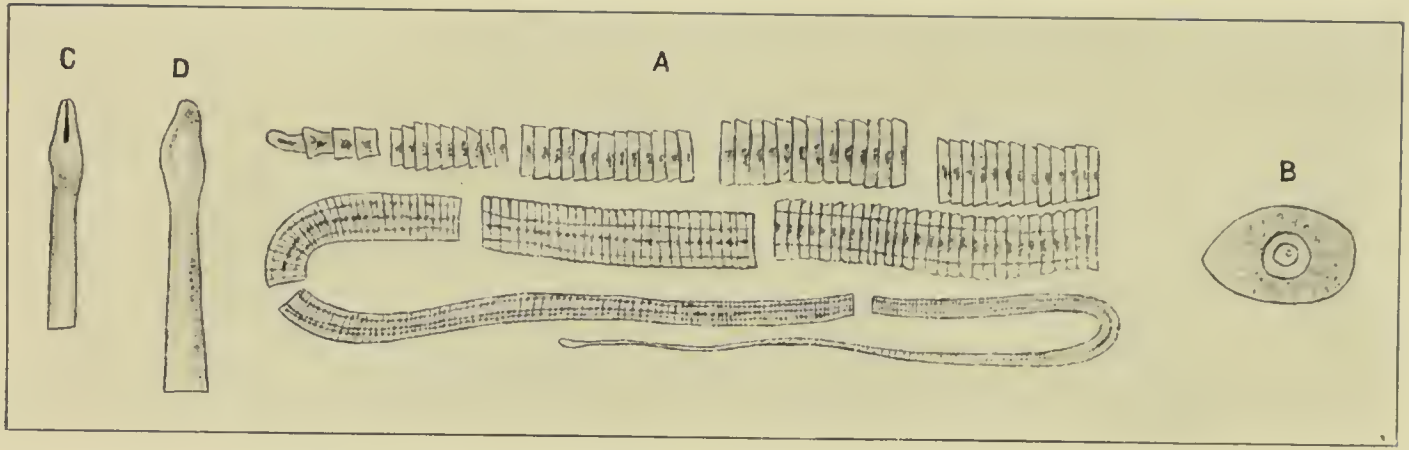
A. Apex and hooks of T. Solium.
B. Head of T. Solium (X 35).



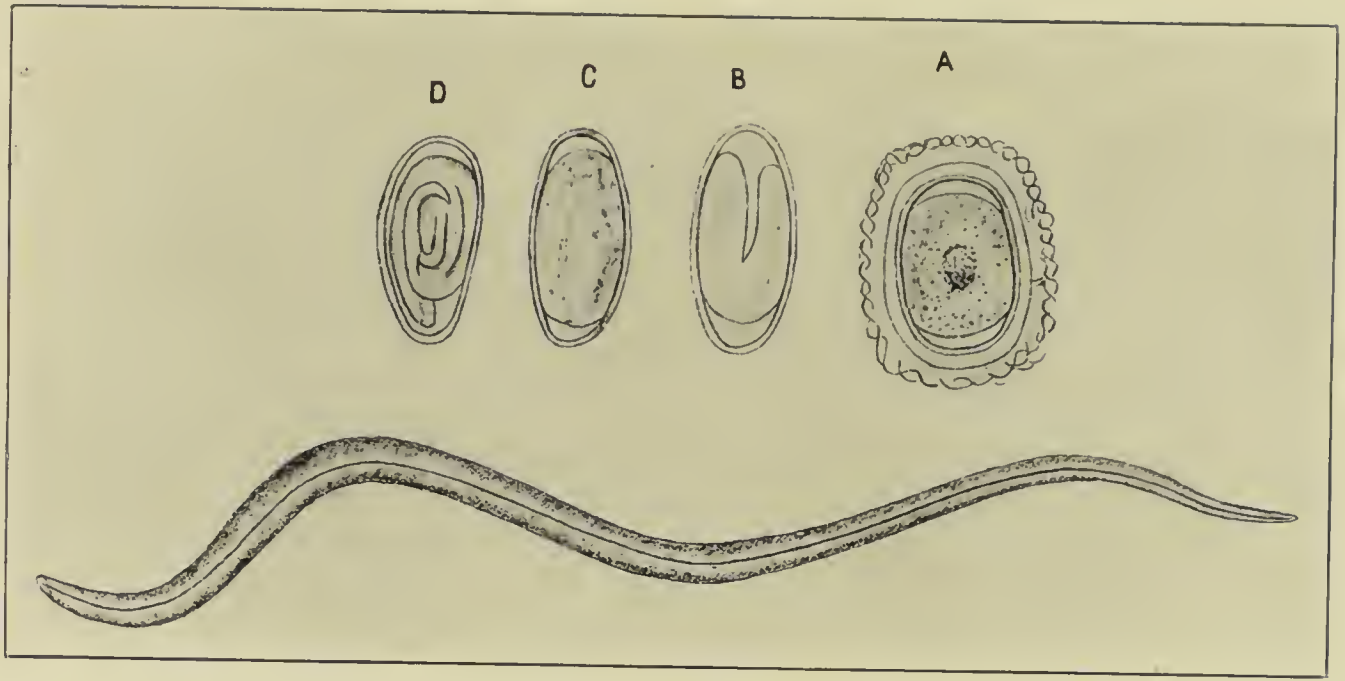
A. Head of T. Mediocan. (contracted).
B. ,, ,, (extended).
C. Embryo, containing egg, of T. Solium.



Tapeworm form of Tænia Mediocanellata (after Leukart).



A. Bothriocephalus Latus.
B. Ovum of B. Latus.
C. Clubhead of B. Latus.
D. Ditto.



Ascaris Lumbricoides (female).

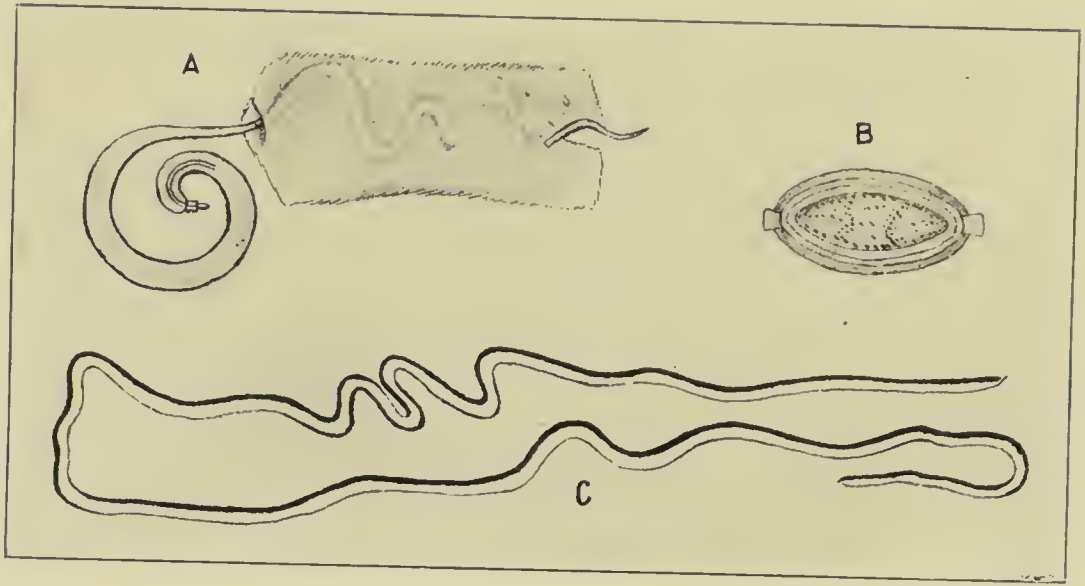
A. Ovum of Asc. Lumb.
B. Ovum of Oxyuris Vermicularis.
C. ,, ,,
D. ,, ,,

a. Oxyuris Verm. (male) (nat. size).
b. Male (magnified).
c. Female (,,).
d. Female (nat. size).

Male.....

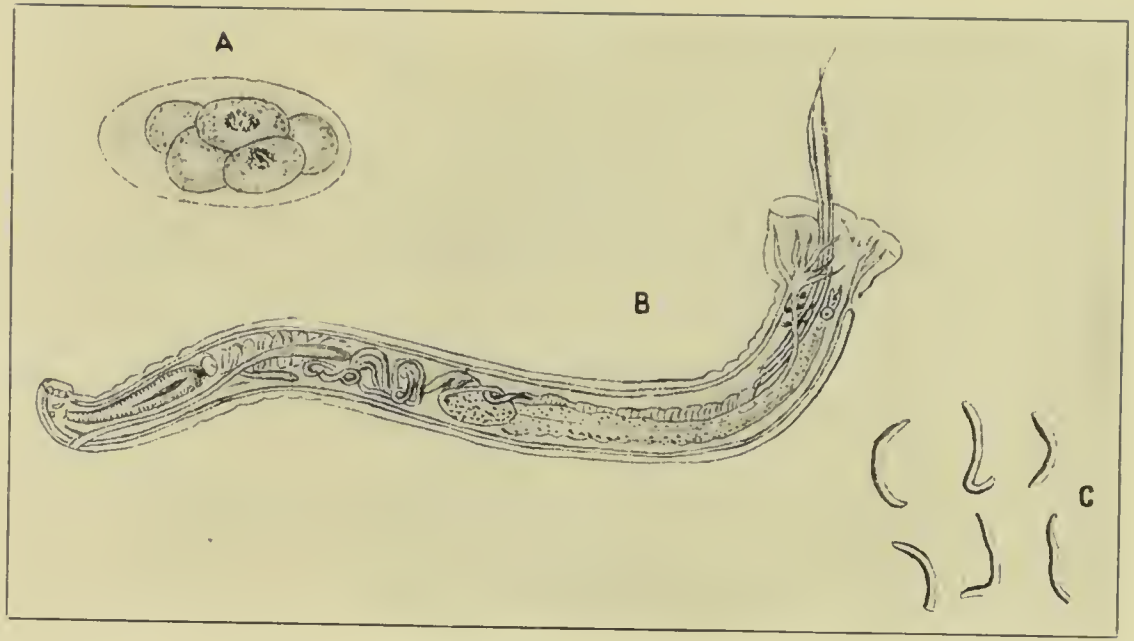
.....Female.

Trich. Disp. (nat. size).



A. Trichocephalus Dispar. (in situ).
B. Ovum of T. Dispar. (Sonsino).
C. Guinea-worm (reduced).

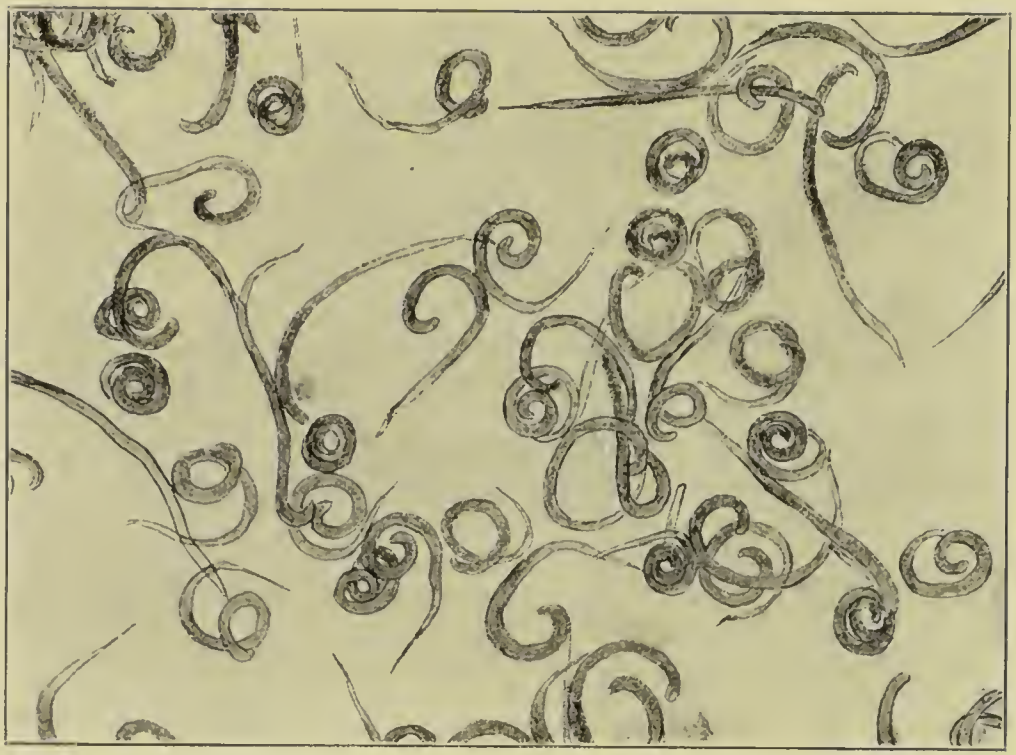
1. Ovum T. Dispar.
2. ,, Ankylos. Duod.
3. Ovum of Ox. Vermicul.
4. ,, ,,
5. ,, ,,
6. Egg from A. Lumbric.
7. Free embryo of Bilharsia.
8. Ovum of B. Latus.
9. Embryo of T. Nymphœa
10. Embryo of T. Solium.



A. Ovum of Ankylos. Duod.
B. Male Ankylos Duod.
C. Male and female Ankylos. (Blanchard).

4. Ova of Ankylos. Duod.
1. Ova of Asc. Lumbric.
3. Ova of Trich. Dispar.
5. Ova of B. Latus.
6. Ova of T. Sol.
2. Ova Oxyr. Vermic.
7. Ova of T. Saginata.

After Fischnet (Rep. of Med.)



Embryos of Guinea-worms.